

**REMARKS**

The present application was filed on October 31, 2003 with claims 1 through 25. Claims 1 through 25 are presently pending in the above-identified patent application. Claims 1 and 22 are proposed to be amended and claim 18 is proposed to be cancelled herein.

In the Office Action, the Examiner objected to the specification due to indicated informalities and objected to the drawings under 37 CFR 1.83(a). The Examiner objected to claims 1, 22, and 25 under 35 U.S.C. 112, first paragraph, for failing to enable the invention and under 35 U.S.C. 112, second paragraph, as being indefinite. The Examiner also rejected claims 1-4, 9, 11-12, 15, 17, and 22-24 under 35 U.S.C. §102(b) as being anticipated by Zhu et al. (United States Patent Number 5,768,183) or as an alternative being obvious over Zhu et al., rejected claims 5-7, 10, 16, 20, 21, and 25 under 35 U.S.C. §103(a) as being unpatentable over Zhu et al., and rejected claim 8 under 35 U.S.C. §103(a) as being unpatentable over Zhu et al. in view of Savtchenko et al. (United States Patent Number 6,545,906). The Examiner indicated that claims 13, 14, 18, and 19 would be allowable if rewritten in independent form including all of the limitations of the base claims and any intervening claims.

**Formal Rejections**

The specification was objected to due to indicated informalities. Regarding the specification, the Examiner asserts that the disclosure is incomplete due to the following ambiguities:

**Point A**

The Examiner asserts that Applicant claims that the invention is based on the single domain theory, but that the disclosure is totally silent on this theory.

The present application teaches the aspects of the single domain theory that are essential to the present invention. For example, the disclosure teaches that, "according to single domain theory, the activation energy barrier of the bit is proportional to the volume of the bit." (Page 2, lines 7-8.) Details of the single domain theory not disclosed are beyond the scope of the present invention. Please also note that the disclosure teaches various elements that are suitable for the magnetic layers (see, page 4, lines 12-17.)

Pages 6-8 of the original specification give a detailed description of the results of the single domain theory. For a more detailed discussed, see, for example, Applied Physics Letters, 84, 2847 (2004) and Applied Physics Letters, 84, 4559 (2004).

5 The applicability of all known ferromagnetic materials is beyond the scope of the present invention. Also, in light of the present specification, a person of ordinary skill in the art would recognize the external fields suitable for use in the present invention.

#### Point B

10 The Examiner asserts that the disclosure fails to show how the shape factor is determined when the two magnetic layers are non-elliptic. It is noted that Layers which are non-elliptic can be approximated by an ellipse of the same aspect ratio.

The determination of the shape factor when the two magnetic layers are non-elliptic would, in light of the present specification, be apparent to a person of ordinary skill in the art.

#### 15 Point C

The Examiner asserts that, although the Applicant indicates that the invention comprises ferromagnetic coupling that required  $J > 0$  and that, when there are no external fields, the coupling will be antiferromagnetic and require  $J < 0$ , the spin flop cycle indicated in FIG. 2 lies entirely in the domain wherein  $J < 0$  and that this means the  
20 predominant coupling is antiferromagnetic.

Applicant notes that the present disclosure teaches that “the phase diagram in FIG. 2 makes it clear that, even though most of the phase exists where  $J$  is negative (antiferromagnetic coupling), this *spin-flop phase extends into the region where  $J$  is positive (ferromagnetic coupling).*” (Page 7, lines 10-12; emphasis added; see, also, FIG.  
25 2 and the line labeled  $h_{sf} = h_{xsat}$ .) Thus, contrary to the Examiner’s assertion, the spin flop cycle indicated in FIG. 2 does *not* lie entirely in the domain wherein  $J < 0$ .

#### Drawings

The drawings were objected to under 37 CFR 1.83(a). Regarding the drawings, the Examiner asserts that the drawings of a semiconductor device wherein the  
30 magnetic layers have a ferromagnetic coupling and have antiferromagnetic net coupling at zero field (in claim 1) must be shown or the features cancelled.

Applicant notes that FIG. 1 is a diagram illustrating an exemplary semiconductor device 100 wherein the magnetic layers have a ferromagnetic coupling and have antiferromagnetic net coupling at zero field. (See, page 4, lines 7-11, and page 5, line 18, to page 6, line 12, of the original disclosure.) Applicant maintains that FIG. 1  
5 meets the requirements of 37 CFR 1.83(a) regarding the Examiner's cited concern and respectfully request that the objection to the drawings be withdrawn.

#### Section 112 Rejections

Claims 1, 22, and 25 were rejected under 35 U.S.C. 112, first paragraph, for failing to enable the invention and under 35 U.S.C. 112, second paragraph, as being  
10 indefinite. In particular, the Examiner asserts that, "since net coupling antiferromagnetic at zero field and ferromagnetic exchange coupling depend on the thickness of the three layers, the shapes of the three layers, the material characteristics of the three layers, the external field (10 different parameters)," that there are insufficient limitations to these parameters in the claims.

15 In light of the present specification, a person of ordinary skill in the art would recognize that the cited parameters are design choices that are selected to meet the limitations recited in claims 1, 22, and 25.

#### Independent Claims 1 and 22

Independent claims 1 and 22 were rejected under 35 U.S.C. §102(b) as  
20 being anticipated by Zhu et al. or as an alternative being obvious over Zhu et al. Regarding claim 1, the Examiner asserts that Zhu discloses that a spacer layer is configured to provide ferromagnetic exchange coupling between the (magnetic) layers, the magnetic layers experiencing anti-ferromagnetic dipole coupling, such that a net coupling of the magnetic layers is anti-ferromagnetic in a zero applied magnetic field.

25 Applicant notes that the Examiner has indicated that claim 18 would be allowable if rewritten in independent form including all of the limitations of the base claims and any intervening claims. Independent claims 1 and 22 have been amended to incorporate the limitation of claim 18.

Thus, Zhu et al. do not disclose or suggest a spacer layer formed between  
30 the magnetic layers, the spacer layer being configured to provide ferromagnetic exchange coupling between the layers, the magnetic layers experiencing anti-ferromagnetic dipole

coupling, such that a net coupling of the magnetic layers is anti-ferromagnetic in a zero applied magnetic field, wherein the spacer layer comprises a weak ferromagnet, as required by independent claims 1 and 22, as amended.

Dependent Claims 2-21 and 23-25

5 Dependent claims 2-4, 9, 11-12, 15, 17, and 23-24 were rejected under 35 U.S.C. §102(b) as being anticipated by Zhu et al. or as an alternative being obvious over Zhu et al., claims 5-7, 10, 16, 20, 21, and 25 were rejected under 35 U.S.C. §103(a) as being unpatentable over Zhu et al., and claim 8 was rejected under 35 U.S.C. §103(a) as being unpatentable over Zhu et al. in view of Savtchenko et al.

10 Claims 2-21 and 23-25 are dependent on claims 1 and 22, respectively, and are therefore patentably distinguished over Zhu et al. and Savtchenko et al. (alone or in any combination) because of their dependency from amended independent claims 1 and 22 for the reasons set forth above, as well as other elements these claims add in combination to their base claim. The Examiner has already indicated that claims 13, 14,  
15 18, and 19 would be allowable if rewritten in independent form including all of the limitations of the base claims and any intervening claims.

All of the pending claims, i.e., claims 1-25, are in condition for allowance and such favorable action is earnestly solicited.

20 If any outstanding issues remain, or if the Examiner has any further suggestions for expediting allowance of this application, the Examiner is invited to contact the undersigned at the telephone number indicated below.

The Examiner's attention to this matter is appreciated.

Respectfully submitted,

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Kevin M. Mason  
Attorney for Applicants  
Reg. No. 36,597  
30 Ryan, Mason & Lewis, LLP  
1300 Post Road, Suite 205  
Fairfield, CT 06824  
(203) 255-6560